

Measuring Computer Science Knowledge Level of Hungarian and Slovakian elementary school students

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***Abstract:** An analysis Computer Science knowledge of Hungarian and Slovakian students was made with the help of a web based Informatics Test. I analysed how effectively can students of different grades answer questions dealing with different subjects. From different towns of Hungary over 60 teachers used the test to see the knowledge level of more than 270 students having answered these questions and from Slovakia more than 390 students. After the evaluation of the test results the correctness of the original presumption emerged. Significance level was 5% through the analysis. Significant divergence by Hungarian students and Slovakian students was found just in 8th grade. In the 8th grade the Hungarian students achieved better results only in the field of spreadsheet calculation.*

***Keywords:** measuring; computer science; knowledge level, slovakian, hungarian, students, elementary school, primary education*

1. Introduction

The education of Computer Science in Slovakia bear a close resemblance to the one in Hungary from the point of view of the discussed materials. Theoretical knowledge, word processing, spreadsheet calculation, database management and programming are parts of the curriculum in all the two countries.

In order to be able to compare the students' knowledge of Informatics in the different countries, we need a detailed analysis. We have to check the various curriculums of the different grades, how many Informatics lessons the students have a week and whether Computer Science is a compulsory or an optional subject. Still, this is not enough to carry out the examination.

We need to check the students' knowledge in various grades in the different countries. To be able to make comparisons between these students, there is a need for a uniform questionnaire in which the questions on different subject matters of Computer Science have to be asked. Only after sending the questionnaire to the

students of the different countries can the survey be carried out on the basis of their answers.

Let's have a look first at how many Informatics lessons are held in the different classes in the respective countries (Table I.). You can choose Informatics only as an elective course in the last two years of the secondary school education in Hungary.

Table I. Number of Computer Science lessons in the different classes

Country	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Hungary	0,5	0,5	0,5	0,5	2	2	2	2	2	2	3*	3*
Slovakia	0	1	1	1	0,5	0,5	0,5	0,5	0,5	0,5*	0,5*	0,5*

* selectable

My starting hypothesis before making the comparison is that the Hungarian students will do better than the Slovakian students.

2. Computer Science Education in Hungary

Computer science education is based on a national basic curriculum in Hungary [1]. According to the National Basic Curriculum (NBC) of Hungary the use of computer science is to be demonstrated in the first four school grades since 2003 (e.g. search on the Internet, painting with computers etc.) and is taught in 1 hour weekly. According to the Computer Science curriculum the following subjects are taught from the 5th grade to the 12th grade at the schools of Hungary in 2 hours weekly:

- Word processing
- Spreadsheet calculation
- Presentation
- Algorithm and programming
- Database management

Generally the Microsoft Office packet is taught and it can be seen that teaching Word processing takes 4 years in Hungary (Table II.). Basic algorithms or rather programming appears in Computer Science sooner, but recursion, list and tree data structures are only selectable part of the curriculum. Database management begins in the 9th grade. In the 11-12 grades CS is just selectable. On basic level it is taught in 2 hours weekly, on a higher level in 3 hours weekly and a final exam can be taken.

Table II. The subjects of CS by grades in Hungary

Subject	Grade								
	5	6	7	8	9	10	11	12	
Word processing		■		■	■				
Spreadsheet calculation				■	■				
Presentation						■			
Algorithm and programming			■	■	■				
Database management					■				

3. Computer Science Education in Slovakia

The education of Informatics from the 2nd grade has been compulsory since the school year of 2008/2009, since the introduction of the school reform but it also appears in the 1st grade as well as in the nursery school curriculum though not as a compulsory subject. It is compulsory to have 1 Informatics lesson a week in the junior section and 0.5 lesson a week in the senior section that can be raised by the schools' own programme. Some schools took the opportunity and increased it to 1 lesson a week. The National Educational Programme does not assign precisely what teachers have to teach in the various grades but announces the school leaving standards to reach at the end of the senior section. So it does not matter if programming is taught in the 6th grade in one school and in the 8th grade in another school; the aim is to reach the school leaving standards. It is part of the educational programme of the school how its students should reach these standards, how many lessons they have a week and at what pace they learn the material; this programme is accepted by the management of the school and its teachers together [2].

The National Educational Programme divides Informatics into 5 topics (it does not specify the number of lessons):

1. Information around us
2. Communication with the help of the means of the ICT
3. Problem solving, thinking with the help of algorithms
4. Basic principles of the operation of the ICT tools
5. IS society

These 5 topics are then to be divided into the school leaving standards.

4. The tools of the Comparison

It is possible to compare the Hungarian and Slovakian education of Computer Science on the basis of examination of the students' knowledge. Since it is a bit difficult to get the questionnaire to the various schools and also the order of the questions can not be changed, the students sitting close to each other in the classroom can see the other's answers, so the most effective solution seemed to be a web-based Informatics test [3].

I took the main topics of Computer Science that can be asked in a test and formed questions of various difficulty. I chose the topics that are part of the education of Informatics in almost every country: theoretical knowledge, word processing, spreadsheet calculation, database management and programming. There can be significant deviations in the curriculum of some countries; therefore I expanded the test with questions on cryptographical knowledge as well as on formal languages and automata since in certain German provinces this is also part of Computer Sciences [4].

The database structure for the test had to be planned in a suitable way so that the data could be obtained later on. The personal data of the students filling in the test are in a separate table and so are their answers to the questions. When filling in the test the students first have to give their actual grade and some other data. If students give the username of their teacher then the teacher also can see how they succeeded and will get a feedback on their progress. *Grade* is important because he/she will get a question sheet depending on the grade given. Students can check topics not taught to them (except basic computer science and office packages). If they check one, the system would not ask questions dealing with the topic but save it with the answer „I have never learned that”. With this option students get fewer questions and answers would flow in at a quicker pace. Next, students can begin to fill in the test.

Every test question has 6 possible answers, only one of which is correct, 3 of them bad, and the 5th choice is: „I have never learned that”, the 6th is: „I have forgotten it”. The answers „I have never learned that” and „I have forgotten it” show which part of the curriculum have the students learned in that grade and if they could remember it or not. Every question has two time limits given in seconds. The first is the minimum time to read, understand and answer the question, the second is the maximum answering time. The software will save the total time used by the student. These time limits are not seen or known by the students. These are used during the evaluation so a correct answer is accepted only if it arrives in the available time interval. Teachers can register on this site too if they are willing to give some of their data. The system is protected by registration code, and registered teachers can log in with username and password. If a student filling in the test gives the username of the teacher too, then the teacher can later see his/her answers and results. Some reports can be generated helping the work of the teacher. It is recorded whether the students have given the right or a wrong

answer. It is also indicated if they have marked it as not learned or if the topic of the question is familiar to them but they have forgotten the right answer.

The evaluation of the answers is only possible after processing the data saved. The first step is to check whether the students of the given country have learned the given topic. If they have not, the comparison with the data of the students of the other countries is impossible to make.

If the students knew the topic because they had learned it, it has to be checked if the time spent answering the questions is within the limits. If it is, the answer can be accepted as right.

You have to calculate the mean and the standard deviation of the right answers in the various grades and countries and make the comparisons with the help of statistical means. In order to be able to do this, you need to have enough students filling in the test in each grade; so the examination can only be carried out supposing you have the required number of students. If you are to compare the IT skills of students in two countries, it is worth to take the Independent Samples T-test.

5. Number of participants

Students filled in the web-test from the 5th grade in Hungary and in Slovakia but so few of the Hungarian students did that in the 6th and 7th grades that I could not make the comparison with them only in the 5th and the 8th grades (Table III.).

Table III. Number of participants

Grade	Hungarian		Slovakian
	Basic education	Informatics course	Basic education
5	79	0	126
6	14	0	114
7	18	0	108
8	169	0	50

6. Survey results of the knowledge of Informatics of the Hungarian and the Slovakian elementary school students

The web-test on Informatics was filled in by altogether 380 students from 22 Slovak cities. We have just observed from which grades there were adequate number of tests filled in for comparison and we have noticed that it is possible to

compare the knowledge of Informatics of the Hungarian and Slovakian students in the 5th and 8th grades. Let's have a look first at the comparison of knowledge of Informatics of the Slovakian students with that of the Hungarian students learning basic Informatics.

6.1. Result by subjects

The following table shows the results by countries and subject (Table IV.). The mean shows how many questions could the students answer, the next column shows the ratio in percentage and the following one shows the standard deviations.

Table IV. The mean and the standard deviation of the right answers of the Hungarian and the Slovakian students

Grade	Subject	Nationality of students	Mean	percent of the correct answers	Std. Deviation
5.	Theoretical knowledge	Hungarian	3,04	75,95%	1,16
		Slovakian	1,91	47,67%	1,29
5.	Word processing	Hungarian	2,46	49,11%	1,49
		Slovakian	1,21	24,19%	1,08
5.	Spreadsheet calculation	Hungarian	0,95	47,47%	0,81
		Slovakian	0,40	19,77%	0,49
8.	Theoretical knowledge	Hungarian	9,20	19,99%	4,94
		Slovakian	7,53	16,37%	5,61
8.	Word processing	Hungarian	4,33	30,90%	2,15
		Slovakian	3,41	24,37%	1,87
8.	Spreadsheet calculation	Hungarian	2,54	13,36%	2,11
		Slovakian	1,76	9,29%	2,02

On the basis of the data in the table we can see that the Hungarian students in the 5th grade performed better since they gave the right answers for more questions. This seems to change in the 8th grade. The topic of database management is not included in the table because no students in this grade had learned it in either country.

Hungarian students do not learn managing database until they start their secondary education. Approximately 5% of the Slovakian students learned database management in the 8th grade.

The Hungarian students do not learn programming at all despite the regulations of the National Core Curriculum that makes it compulsory from the 7th grade. The Hungarian students achieved better results in word processing throughout the test and gave the proper answer to approximately half of the questions while the Slovakian students knew the right answer to only a quarter of the questions. Hungarian students do not learn programming at all only if they choose Informatics as an optional subject in the second half of secondary school. The National Core Curriculum assigns teaching programming to students from the 7th

grade in vain; it unfortunately does not get realized. In Slovakia one third of the students in the 8th grade have already learned programming and at least half of them have met the topic of algorithmical thinking by the end of their secondary school years.

In many cases it is not enough to examine the results in percentage in order to compare the students' achievements. It can only be stated unambiguously after the statistical analysis in which grades and in which topics there were significant differences between the students from the different countries. The results of the Independent Samples T-test with regard to the Hungarian and Slovakian students learning basic Informatics on the basis of topics and grades

6.2. Analysis of the means by subjects

The next step in the analysis was to inspect whether the means by subject would differ if using the Independent samples test. The null hypothesis was that no significant difference would exist between the means of all subjects by countries. Because of having two independent samples it was possible to use the T-test to decide whether the hypothesis was true or not (Table V). If the analysis of the results (*Levene test*) showed the variance of the two groups different ($p < 0,05$) [5], in this case the means could be compared with *Welch's t test* ($p < 0,05$) [6], else the means could be compared with *T-test* ($p < 0,05$) [7].

Table V. Independent sample test of the Hungarian and the Slovakian students

Grade	Subject	Levene's test for Equality of variances		T-test for equality of means		means are different
		F	Sig.	t	Sig. (2-tailed)	
5.	Theoretical knowledge	1,52	0,22	4,95	0,00	yes
5.	Word processing	7,39	0,01	5,30	0,00	yes
5.	Spreadsheet calculation	0,03	0,86	3,15	0,00	yes
8.	Theoretical knowledge	0,30	0,58	1,31	0,19	no
8.	Word processing	0,52	0,47	1,69	0,09	no
8.	Spreadsheet calculation	2,49	0,12	2,21	0,03	yes

The table above contains the results of the Independent Samples T-test and in the last column it can be seen if there are any differences between the knowledge of the Hungarian and Slovakian students in the respective grades concerning the given topics. On the basis of this it has been confirmed that the Hungarian students in the 5th grade were better at all the three topics. In the 8th grade they achieved better results only in the field of spreadsheet calculation. Slovakian students go on learning programming while Hungarian students have to renounce it in the basic Informatics training.

Conclusions

My starting hypothesis according to which the Hungarian students will do better than their Slovakian peers has only partly been justified.

We have found topics not taught in either of the countries. Examining the efficiency of teaching Informatics in Slovakia and in Hungary we could see that in the beginning the Hungarian students do better concerning theoretical knowledge, they receive a better basic education as a start but then this advantage becomes equalized.

The Hungarian students perform better at spreadsheet calculation during the whole test; the teachers seem to put the emphasis on this topic in our country.

The starting advantage in word processing disappears by the end of the elementary school; the Slovak students provide the same results.

Slovakian students learn to make algorithms in the 8th grade already; their Hungarian peers do not meet this topic until they finish their elementary school in spite of the fact that students should start dealing with this topic in the 7th grade already according to the regulations of the National Core Curriculum.

We have analysed the Computer Science Knowledge level of the Hungarian and Romanian students too[8] and we have got interested achievement, that can be used by the comparison of international CS education like this paper.

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References

- [1] <http://www.okm.gov.hu/kozoktatas/tantervek/nemzeti-alaptanterv-nat>; Retrieved June 24, 2011
- [2] <http://www.minedu.sk>; Retrieved June 24, 2011
- [3] <http://nero.banki.hu/informatiktest>; Retrieved June 24, 2011
- [4] The Concept to Measure and Compare Students Knowledge Level in Computer Science in Germany and in Hungary / *Acta Polytechnica Hungarica*, 2008 Volume 5., pp:145-158, 2008, ISSN: 1785-8860
- [5] http://en.wikipedia.org/wiki/Levene's_test; Retrieved June 24, 2011
- [6] http://en.wikipedia.org/wiki/Welch's_t_test; Retrieved June 24, 2011
- [7] http://en.wikipedia.org/wiki/Student's_t-test; Retrieved June 24, 2011
- [8] Measuring Computer Science Knowledge Level of Hungarian and Romanian students / 2011 International Conference on Intelligent Computing and Integrated Systems, Guilin, China, 2011